Effect of colour discrimination on spatial contrast sensitivity

Hagen, LA[1], Baraas, RC[1]

[1] Department of Optometry and Visual Science, Buskerud University College, Kongsberg, Norway

Achromatic contrast sensitivity at low spatial frequencies might be better for observers with balanced L/M-cone ratios, as increased pooling of signals between different types of cones is thought to improve signal-to-noise ratios at these spatial frequencies (Hsu et al., 2000, JOSA A, 17, 635-640). Here, contrast sensitivity was measured at a range of spatial frequencies for groups of observers with varying degrees of colour-discrimination ability. Eight normal trichromatic males, eight normal trichromatic females, five deuteranomalous trichromatic males, and five female carriers of a deutan colour-vision defect were classified with a battery of colour-vision tests. Spatial contrast sensitivity was tested with horizontally oriented Gabor patches (full-width-at-half-height of 1.0 deg) at ten different spatial frequencies from 1.2 - 31.0 c deg^{-1}. Observers were corrected to best logMAR letter acuity and viewed the stimuli monocularly through a 2.8 mm artificial pupil from a distance of 6 m. Average luminance of the Gabor patch was 35 cd m^{-2}. There were distinct group differences between normal trichromats, carriers and deuteranomalous observers with regards to colour discrimination. There was no difference in contrast sensitivity for high or medium spatial frequencies between the groups. Normal trichromatic females had significantly better sensitivity than deuteranomalous males at the lowest spatial frequencies, with normal males and carriers having marginally better sensitivity than the deuteranomals. The normal trichromatic females were significantly better at 1.2 c deg^{-1} relative to both groups of males, and at 2.0 c deg^{-1} relative to deuteranomalous males and carriers of deutan deficiency. The main difference between the four groups of observers is that normal trichromatic females probably have a higher density of M cones than the others, and therefore an L/M-cone ratio that is closer to two (Miyahara et al., 1998, Vision Research, 38, 601-612), indicating that variations in L/M cone ratios might be the reason for the observed difference at low spatial frequencies.

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